

REMARKS

Claims 1-8 and 10-21 were pending in the present application. Claim 23 has been added. Support for newly added Claim 23 can be found throughout the specification.

Applicants submit herewith a §1.132 Declaration that provides supporting evidence that the plasmas disclosed by the primary reference, US Patent No. 6,242,350 to Tao, are oxidizing plasmas.

Reconsideration and allowance of the pending claims is respectfully requested in view of the following remarks and the §1.132 Declaration filed concurrently herewith.

Claim Rejection Under 35 U.S.C. §102

Claims 1-3 and 9-22 are rejected under 35 USC 102(b) as allegedly anticipated by US Patent No. 6,242,350 to Tao et al. (hereinafter “Tao”). Applicants respectfully traverse.

As discussed in Applicants’ previous response, to anticipate a claim, a reference must disclose each and every element of the claim. *Lewmar Marine v. Varient Inc.*, 3 U.S.P.Q.2d 1766 (Fed. Cir. 1987).

Tao fails to anticipate Claims 1-3 and 9-22 because Tao fails to teach the use of neutral plasma, i.e., neutral chemistry. Rather, Tao teaches the use of oxidizing plasma as supported by the data presented in the §1.132 Declaration filed concurrently herewith.

In the §1.132 Declaration, Applicants have analyzed various plasmas produced from a variety of gas flow ratios employing optical emission spectroscopy (OES) and residual gas analysis (RGA) techniques. The plasma was generated from the various gas mixtures in a microwave plasma generator at a power of 1,500 Watts and a pressure of 1.5 Torr. As demonstrated by Exhibits A and B, the plasma generated under these conditions was determined to be oxidizing when the hydrogen concentration in the gas mixture was less than about 2.5 percent, which corresponds to an oxygen/forming gas ratio (3% H₂ in N₂) of greater than about 1.2 : 1. In contrast, reducing plasmas were formed under these plasma conditions at hydrogen

concentrations greater than 3.7 percent, which corresponds to hydrogen/oxygen gas ratios less than 0.8: 1. At a hydrogen concentration of about 3 percent, neutral plasma was observed, which comprises a relatively narrow window with respect to the oxidizing and reducing regimes. As argued in the previous Declaration dated March 26, 2004, the generation of atomic species in a plasma environment from a gas mixture cannot be simply correlated to the flow ratios of the components of the plasma gas mixture. Rather, the final ratio of atomic hydrogen and atomic oxygen species generated from a gas mixture is based on many factors, including, but not limited to the following: the presence of other gases such as water vapor, the pressure in the reactor, the applied power, the dissociation efficiency, the distance from the generation region to the substrate surface, interactions between species, surface recombination effects (that affect individual species differently), and the like.

In Tao, the hydrogen concentration was calculated to be 2.44 percent (1,800 sccm oxygen and 440 sccm forming gas). Based on the data presented in Exhibits A and B, the plasma produced by Tao are likely to be oxidizing. The fact that the % hydrogen in the gas mixture is 2.44%, which would clearly be oxidizing under the conditions provided by Applicants, leads one of ordinary skill in the art to conclude that the plasma generated by Tao are oxidizing.

In view of the foregoing, it is submitted that Tao fails to anticipate the processes employing neutral plasma, and as such, the rejection applied to Claims 1-3 and 9-22 should be withdrawn.

Newly added Claim 23

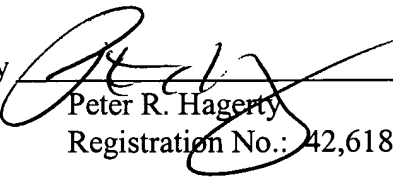
It is noted that Tao only discloses RF generated plasmas. There is no disclosure of microwave generated neutral plasma.

It is believed that the remarks fully comply with the Office Action and that the claims herein should now be allowable to Applicants. Accordingly, reconsideration and allowance is requested.

If there are any additional charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130 maintained by Applicants' Attorneys.

Respectfully submitted,

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Han et al.)	
)	Group Art Unit: 1746
Serial No.:	09/864,003)	
)	
Filed:	May 23, 2001)	
)	Examiner: Markoff, Alexander
For:	PLASMA PROCESS FOR REMOVING)	
	POLYMER AND RESIDUES FROM)	
	SUBSTRATES)	

DECLARATION PURSUANT TO 37 C.F.R. § 1.132

VIA FACSIMILE TO: 703-872-9310
Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

I, Qingyuan Han, declare and state:

1. My educational background includes a Masters of Science in mechanical engineering from the University of Minnesota and a Ph.D. in mechanical engineering from the University of Minnesota.
2. I have been employed by Axcelis Technologies, Inc. since December 1997, where I am currently a Principal Scientist in the Advanced Technologies Group at Axcelis Technologies, Inc. in Rockville, Maryland.

3. I am an inventor or co-inventor on at least 3 U.S. patents assigned to the Axcelis Technologies, Inc. and at least 12 pending applications relating to plasma processing and plasma apparatuses.

4. I am an inventor of the invention claimed in the above-identified application.

5. I designed and supervised residual gas analysis (RGA) and optical emission spectroscopy (OES) studies for analyzing the ratios of hydrogen and oxygen species generated from various gas mixtures that were exposed to microwave energy to form plasma.

6. Exhibit A illustrates OES data for various gas ratios that were used to generate reducing, oxidizing and neutral plasmas. The various plasmas were generated by exposure to microwaves at 1,500 watts and a pressure of 1.5 Torr. The gas compositions consisted of O₂ and Forming gas (3% H₂ in N₂). Exhibit A illustrates emission of atomic oxygen and hydrogen as a function of the amount of H₂ in O₂. As shown, the plasma generated under these conditions was determined to be oxidizing when the hydrogen concentration in the gas mixture was less than about 2.5 percent, which corresponds to an oxygen/forming gas ratio (3% H₂ in N₂) of greater than about 1.2 : 1. In contrast, reducing plasmas were formed under these plasma conditions at hydrogen concentrations greater than 3.7 percent, which corresponds to hydrogen/oxygen gas ratios less than 0.8: 1. At a hydrogen concentration of about 3 percent, neutral plasma was observed, which comprises a relatively narrow window with respect to the oxidizing and reducing regimes.

7. Exhibit B provides comparative data for OES and RGA analysis of the plasmas, which appear to correlate to one another. In both analytical techniques, oxidizing plasmas were

observed when the H_2/O_2 ratio was less than 2.5

8. Tao discloses a hydrogen concentration of 2.44 percent (1,800 sccm oxygen and 440 sccm forming gas). Based on the data presented in Exhibits A and B, the plasmas produced by Tao are likely to be oxidizing. The fact that the % hydrogen in the gas mixture is 2.44% supports the conclusion that the plasma generated by the RF conditions provided in Tao are oxidizing.

9. I further declare that all statements and representations made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements and representations were made with the knowledge that willful false statements and the like, so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued therefrom.

8-2-2004

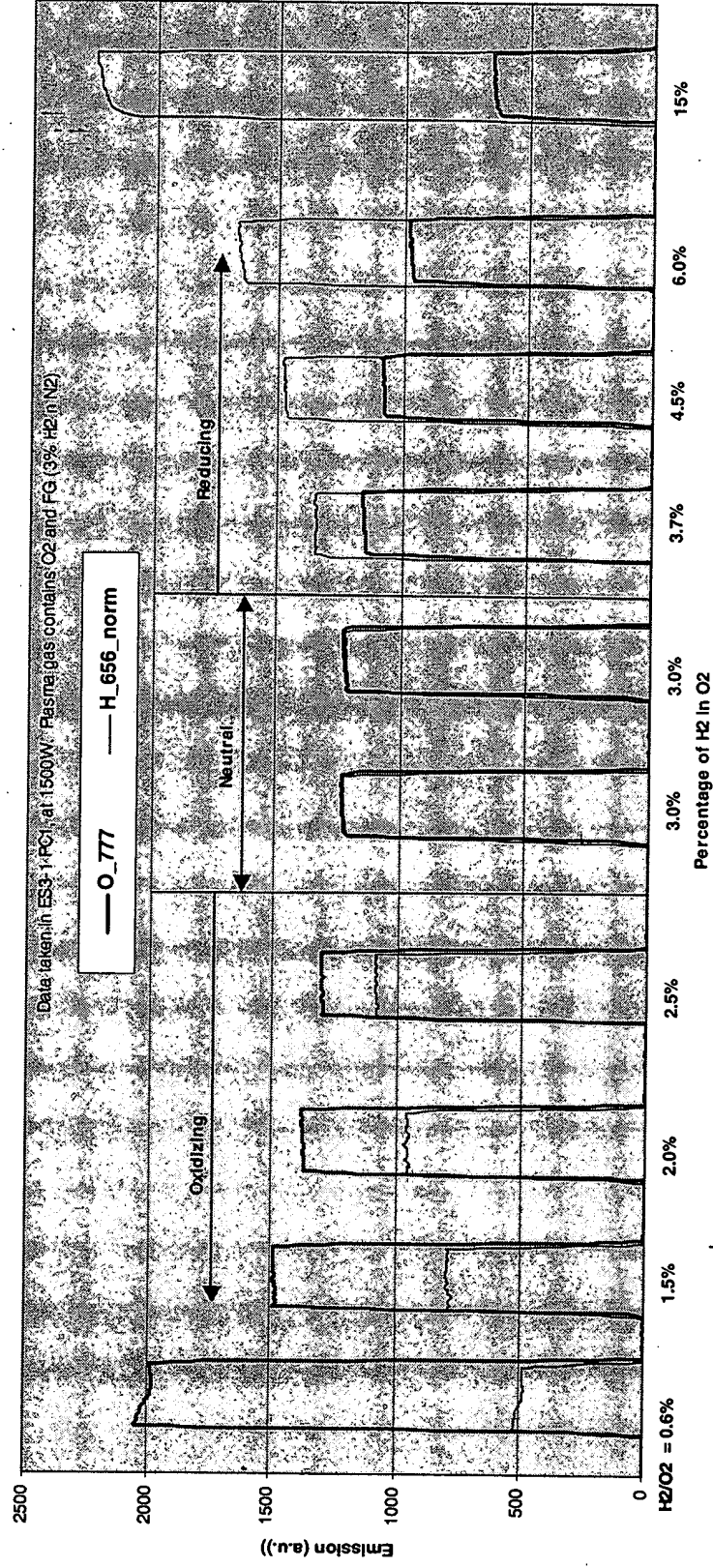
Dated

Qingyuan Han
Qingyuan Han, Ph.D

OES Data: Atomic Hydrogen vs. Atomic Oxygen

Oxidizing – Neutral – Reducing

Oxidizing, Neutral, and Reducing Plasma Regions based on OES Data Analysis



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OES and RGA Analysis Results

Data taken in the ES3-1 PC1 tool (downstream microwave plasma chamber) at 1.5 torr and 1500W.

Plasma gas mixture contains O2 and FG (3% H2 in balanced N2). O2 to FG flow ratio varies from 5:1 (oxidizing) to 1:5 (reducing)

Atomic hydrogen values in RGA and OES data are normalized to define the neutral region with respect to the O2/FG ratio = 1:1.

Plasma Gas: O2/FG Ratio	5:1	2:1	3:2	1.2:1	1:1	0.8:1	2:3	1:2	1:5
Plasma Gas: H2/O2 %	0.6	1.5	2.0	2.5	3.0	3.7	4.5	6.0	15
RGA Results: H/O		0.53	0.65	0.80	1.00	1.11	1.38	2.21	
OES Results: H/O	0.25	0.53	0.70	0.84	1.00	1.17	1.37	1.71	3.48



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